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ABSTRACT

The Theory of Reasoned Action was used to ascertain students' salient beliefs, correlations between constructs in the theory, relative weights of the determinants of intention, and the effect of type of schooling, gender, and grade level on the determinants of intention. This exploratory study generated baseline information and used correlational analyses. The study's three stages included elucidation interviews with a subsample of students and construction of the instruments, a pilot study and refinement of the instruments, and final collection of data and analysis. Multistage cluster sampling was used to select 377 public school students. Also involved were 46 private school students and 34 home school students. It was found that students' "attitude toward" and "their subjective norm" with respect to science learning behaviors explained a significant amount of variance in intention to do laboratory and non-laboratory activities. Home school students had beliefs that comprised a more positive attitude toward doing laboratory science than did public and private school students. There were significant relationships between grade level and beliefs for both laboratory and non-laboratory science; and between gender and laboratory science. (CW)

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Students' Intentions to Engage in Science Activities: Public, Private, and Home Schools

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Running Head: PUBLIC, PRIVATE, AND HOME SCHOOLS

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Abstract

The beliefs, attitudes, and intentions of public, private, and home school students (grades 3 to 8) with respect to laboratory and non-laboratory science were examined. The Theory of Reasoned Action was used to ascertain students' salient beliefs, correlations between constructs in the theory, relative weights of the determinants of intention, and the effect of type of schooling, gender, and grade level on the determinants of intention.

This exploratory study generated baseline information and used correlational analyses. The study's three stages included elicitation interviews with a subsample of students and construction of the instruments, a pilot study and refinement of the instruments, and final data collection and analyses. Multistage cluster sampling was used to select 377 public school students; 46 private school students and 34 home school students were involved. Interviews with a random subsample of 20% of the subjects provided the salient beliefs upon which to base the construction of the instruments. Validity of the instruments was assured by close adherence to the Theory of Reasoned Action and the procedures outlined by the theory's authors. Readability of the instruments was adjusted to an appropriate level; the instruments were also read aloud to the subjects. It was assumed that students responded in a reliable manner.

Eleven behavioral beliefs and six normative beliefs accounted for over 79% of the subjects' responses with respect to laboratory science. Eight behavioral beliefs and seven normative beliefs accounted for over 80% of the responses for non-laboratory science. Alpha was set at .10. Attitude toward behavior and subjective norm explained a significant amount of variance in intention to do laboratory science activities ($\underline{R}^2$ = .14, $\underline{F}$[2, 219] = 18.56, $\underline{n}$ = 222, $\underline{p}$ = .00) and a significant amount of variance in intention to do non-laboratory activities ($\underline{R}^2$ = .27, $\underline{F}$ [2, 226] = 42.89, $\underline{n}$ = 229, $\underline{p}$ = .00). The relative weight of the attitude toward behavior was greater than that of the subjective norm for both laboratory and non-laboratory. All correlations between the various other adjacent constructs in the theory were significant for both studied behaviors. Home school students had beliefs that comprised a more positive attitude toward doing laboratory science than did public and private school students.

There was a significant relationship between grade level and beliefs for both laboratory and non-laboratory science; the general pattern was that older students had lower intentions to do science. There was a significant relationship between gender and normative beliefs for laboratory science; females believed more strongly that significant others wanted them to engage in their assigned science activities.

Researchers might use this information to design experimental studies to test the effects of influencing salient beliefs and, ultimately, actual science learning behavior. Investigators might explore the environment of the home school in order to determine why home educated students appear to have such a positive attitude toward science activities and appear to have high science achievement. Teachers might use knowledge of these students' beliefs to attempt attitudinal and behavioral change in the science learning environment.

Teachers of science are constantly striving to engage students in the activities that the teachers plan. The activities, whether hands on, discovery, or teacher lecture, are devised in order to enhance learners' scientific literacy. However, students don't always engage in the learning activities provided by the teacher. Teachers want to know how they can increase the likelihood that their students will actually **do** and **learn** science.

The purpose of this study was to gather information about the determinants of young students' behavior with respect to laboratory and non-laboratory science learning activities. A particular focus of this study was to ascertain whether the type of school (i.e., public, private, or home), grade level, and gender had any effect on students' beliefs and thus intentions to engage in science learning activities. More specifically, the purpose of the study was to answer the following questions by using the theory of reasoned action (Fishbein & Ajzen, 1975): (1) What are the salient beliefs of students with respect to engaging in laboratory and non-laboratory activities?, (2) What are the correlations between adjacent components in the theory of reasoned action?, (3) What are the relative weights of the immediate determinants (i.e., attitude toward the behavior and subjective norm) of student intention to engage in science learning behaviors, and (4) Is there a relationship between the external variables of type of school, grade level, and gender and student intentions to do science?

Rationale for the Study

Science educators strive to engage students in behaviors that will enhance their scientific literacy. Various constructs that can be evaluated via observation of specific behaviors have been delineated and are targeted by science educators (Collette & Chiapetta, 1989; National Science Teachers Association, 1982). It has been recognized that science educators need a clear idea and sufficient information regarding children's intentions, and the determinants of those intentions, to engage in science learning behavior (Ray, in press). Knowledge of the determinants would inform science educators as to how they

might better ensure that young people will participate in science activities. Experiments could then be conducted to establish causal relationships.

Several authors have recognized that a coherent approach to changing science learners' behavior has been lacking and they have called for theory- and research-based approaches to science education research in the area of attitudes (Haladyna, Olsen, & Shaughnessy, 1983; Koballa & Crawley, 1985; Linn, 1987; Zeidler, 1984). Fortunately, there is substantial evidence to suggest that the construct most closely associated with behavior is behavioral intention (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Fishbein and Ajzen have developed the "theory of reasoned action" which deals with behavioral intention and its determinants. The theory of reasoned action has recently entered the realm of science education research as a tool for understanding and potentially changing science learning behavior (Koballa, 1986, 1988, 1989; Krynowsky, 1988; National Association for Research in Science Teaching, 1988; Ray, in press; Stead, 1985).

Theory of Reasoned Action

The theory of reasoned action has helped researchers understand the precursors of intention. The model is founded on the assumption that most socially relevant actions are under volitional control, and a person's intention to perform a behavior is the immediate determinant of the action (Ajzen & Fishbein, 1980). The paradigm's main use is the prediction and understanding of behavior and its determinants. It is theorized "... that people use the information available to them in a reasonable manner to arrive at their decisions" (Ajzen & Fishbein, 1980, p. 244) regarding particular behaviors. The information a person has serves as the basis of his or her beliefs.

The model can be represented by three equations (Fishbein & Ajzen, 1975):

$$(1) \quad B \approx BI = w_1(A_b) + w_2(SN)$$

$$(2) \quad A_b = \sum_{i=1}^{n} b_i * e_i$$

$$(3) \quad SN = \sum_{j=1}^{m} nb_j * mc_j$$

Using the model, it is supposed that the intention (BI) to perform a certain behavior (B) is a function of the weighted (w_1) attitude toward performing a behavior (A_b) and the weighted (w_2) subjective norm (SN) (eq. 1). Ergo, a behavioral intention consists of a personal and social component.

Attitude toward the behavior is the individual's feelings about performing the behavior. It is a function of the beliefs (b_i) about expected consequences or outcomes of the behavior and the evaluations (e_i) of these outcomes. Attitude toward behavior can be measured directly by asking the person to rate the performance of the behavior on a scale, or it can be measured indirectly by summing salient attitudinal belief scores (i.e., b_i*e_i scores) (eq. 2).

Subjective norm is the person's perception of the pressures by important others, or referents, to perform the specific behavior. It is a function of normative beliefs (nb_j), or who might want them to perform the behavior, and the motivations to comply (mc_j) with the referents. As for the personal component, subjective norm can be measured directly, or indirectly by summing salient normative belief scores (i.e., nb_j*mc_j scores) (eq. 3). Figure 1 symbolizes the model.

The theory of reasoned action also considers the construct of external variables (e.g., personality traits or demographic variables). The theory explains that external variables are related to behavior only if they are related to one or more of the variables within the theory (Ajzen & Fishbein, 1980). The authors of the theory have explicated a number of ways that the relation between an external variable and behavior can be mediated (Ajzen & Fishbein, 1980).

The theory of reasoned action has been used to investigate a wide variety of behaviors (Bowman & Fishbein, 1978; Hom & Hulin, 1981; Koballa, 1986, 1988, 1989; Lin, 1987; Ray, in press; Riddle, 1980; Stead, 1985). This study uses the theory to generate further baseline information and understanding concerning the determinants of children's intentions to engage in science learning behaviors.

External Variables

Science education research should include external variables (e.g., age, type of schooling) if there are research-based reasons to believe that those variables might affect the determinants of science learners' intention (Ajzen & Fishbein, 1980; Ray, in press). Three external variables are considered in this study: grade level, gender, and type of school. Many students lose interest in science or their perceptions of science degenerate during grades 4 to 8 (Linn, 1987; Yager & Penick, 1986). In a similar vein, Talton and Simpson (1986) pointed out that "As more is understood concerning how adolescent students form attitudes toward science, policy changes can be made that will affect curriculum and instruction in science in American schools" (p. 366). This study, therefore, examines the external variable of grade level in order to determine whether it has an influence on the determinants of intention to do science. Information about students in grades 4 to 8 might lead to ways of maintaining their interest in science.

Various reports, though not all, have indicated differences between males and females in terms of their science achievement and attitudes toward science. Schibeci (1983) reported that "sex appears to influence attitudes: boys display more favorable attitudes to science than girls" (p. 599). Cannon and Simpson (1985) studied seventh grade life science students and found, "... there are significant differences in science attitude and achievement by gender. Males had more positive attitudes toward science and achieved higher ..." (p. 134). Hasan (1985), studying eleventh grade students, and Simpson and Oliver (1985), dealing with grades 6 to 10, found gender-related differences in attitude. Willson (1983) used a meta-analysis and found gender differences regarding the relationship between science achievement and science attitude for elementary through college students. On the other hand, Welch, Walberg, and Fraser (1986) found gender differences among 9 year olds on the variable of achievement but not on attitude. Further, the meta-analysis of Shymanksy, Kyle, and Alport (1983) revealed a variety of relationships and lack of relationships between gender and achievement and attitude. Linn, Benedictis, Delucchi, Harris, and Stage (1987) analyzed data which showed gender differences and provided a logical explanation for why the differences might exist. Among other things, they suggested that the gender difference in knowledge is not necessarily the result of inherent male-female differences. In summary, the research

findings are ambivalent concerning gender differences as related to attitudes toward science and science achievement. This study will use the theory of reasoned action to explore gender differences at the critical grades 3 to 8 level.

Home education is a type of schooling that has shown tremendous growth in the past decade (Knowles, 1988). There is strong concern by some that home education cannot provide children with an adequate education (National Association of Elementary School Principals, 1989-1990; National Education Association, 1988). Other professional educators take a more moderate view of home education (National Association of State Boards of Education, 1988). Regardless of opinion, research on home education shows home school students faring equal to or better than their conventional school peers in terms of both academic achievement and social/emotional adjustment (Montgomery, 1989; Ray, 1988). More specifically, the home educated appear to do quite well in terms of science achievement (Wartes, 1989) and areas of cognitive development that might enhance their science learning (Quine & Marek, 1988). Use of the theory of reasoned action and research evidence about the achievement of home school students would suggest that they have strong intentions to engage in science learning. These intentions would in turn be due to high positive attitude toward doing science. On the other hand, logic might suggest that since home school students generally don't have professionally trained teachers, their attitudes toward doing science and achievement might be lower than that of public and private school students. Along the same line of thought, extensive studies have suggested that private school students do better in terms of academic achievement than do those in public schools (Coleman & Hoffer, 1987; Coleman, Hoffer, & Kilgore, 1982). The theory of reasoned action is used in this study to explore whether there is in fact a "type of school" effect with respect to intentions to engage in science learning.

Science educators need information that would be useful in changing science learners' ideas (Linn, 1987). This study's procured baseline knowledge and understanding related to science learning behavior and how the external variables of grade level, gender, and type of schooling could be used to develop and execute experimental research. That is, results of initial research might be used, for

example, to inform a behavioral change method such as Hovland's persuasive communication approach (Martin, 1985; Shrigley, 1983) or Lewin's group dynamics approach (Shrigley, 1983). In fact, Koballa (1989) recently used the theory of reasoned action to design an effective persuasive message targeted at preservice elementary teachers. As Shrigley (1983) noted, "... science educators interested in modifying attitudes can expect an accompanying change in behavior" (p. 431).

Method

This study was designed to be exploratory, to generate baseline information, and to use correlational analyses. The study progressed in three stages. Stage I involved (a) selection of students, (b) elicitation interviews with students, and (c) construction of the instruments. Stage II was a pilot study including (a) development of procedures for administering the instruments and (b) review/revision of instrumentation after collecting data from a sample. Stage III involved (a) final data collection and (b) the analysis of data.

The population consisted of grades 3 to 8 children in public, private, and home schools in the mid-Willamette Valley region of Oregon. Three public school districts were chosen to represent a variety of students in terms of demographic characteristics. Selection by school district administrators and random selection via multistage cluster sampling (Borg & Gall, 1989) was used to determine the classes of public school students that were used in the study. School district A contained two cities, each with populations near 5,000, and a small state college. School district B consisted of a city with a population of about 28,000 and contained a community college. School district C consisted of a city with a population of about 42,000 and contained a large state land grant university. Random selection via multistage cluster sampling (Borg & Gall, 1989) was used to select the 18 classes of students that were used in the study and the 6 classes that were included in the pilot study. One Christian school in the region readily agreed to participate. Home school support group networks were used to solicit a sample for participation in the study.

A sample of 226 subjects (n = 187 public, 22 private, and 17 home) was used for the laboratory behavioral intention and 231 subjects (n = 190 public, 24 private, and 17 home) were used for the non-

laboratory behavioral intention in Stage III of the study. About 20% (n = 90; 72 public, 12 private, and 6 home) of these students were randomly selected and interviewed in Stage I in order to elicit their salient attitudinal and normative beliefs. The responses of the public school students were quantitatively and subjectively analyzed in order to categorize them for later development of the instrument (Ajzen & Fishbein, 1980). The responses of the private and home school students were subjectively compared to those of the public school students in order to determine whether adjustments should be made in terms of which items should be included in the final instrument. A completely separate group of classes and students was randomly selected from the involved public schools for the pilot study.

Instrumentation

The behavioral intention items for the laboratory and non-laboratory instruments were worded with special attention given to the elements of action, target, context, and time (Ajzen & Fishbein, 1980). It was decided that stating a time frame (e.g., in the next two weeks) was unnecessary and would unduly complicate the behavioral statement for the young subjects. The behavioral intention item for laboratory was stated as follows:

I plan to do the science projects and science experiments my teacher asks me to do.

The behavioral intention item for non-laboratory was stated as follows:

I plan to do the science reading and science writing my teacher asks me to do.

Students were randomly assigned to either the laboratory group or the non-laboratory group. The procedures of Ajzen and Fishbein (1980) were followed for elicitation sessions with students and for developing the instruments. Validity was assured via adherence to the theory of reasoned action and the instrument construction procedures proposed by the theory's authors (Ajzen & Fishbein, 1980; also see Ray, in press). The content validity of the item scales was also evidenced by their correspondence with the behavioral criteria (Ajzen & Fishbein, 1980; Koballa, 1986). The behavioral beliefs, outcome evaluations, normative beliefs, and motivation to comply items for the instrument were defined based upon the results of the analysis previously described. The item construction pattern that was delineated by Ajzen and Fishbein (1980) was followed. Therefore, each of the two instruments consisted of seven

subcomponents. Each subcomponent consisted of from 1 to 11 items. Each of the seven subcomponents could not necessarily be considered a subtest because the items in some of the subcomponents of the instrument were not homogeneous.

The predictive items were measured on five-point semantic differential scales. Except for the motivation to comply scales, which were scored from +1 (no) to +5 (yes), all scales were scored from -2 (e.g., bad) to +2 (e.g., good). Five response options (as used by Stead, 1985), rather than seven (as suggested by Ajzen & Fishbein, 1980), were used so that there would be fewer vague options for the young students.

Validity was assured via careful adherence to the theory of reasoned action model and the instrument construction procedures proposed by the theory's authors. The content validity of the item scales was also evidenced by their correspondence with the behavioral criteria.

Self-report instruments, such as those used in this study, are consistent with the model. The self-report instrument is a common and useful means of measuring subjects' affect. An assumption of this study was that the subjects were willing and able to report accurately on the concepts represented by the items on the instruments (Gronlund & Linn, 1990). The nature of the instrument (previously discussed) made it inappropriate to quantitatively analyze its reliability.

The readability of the instrument was ascertained via the Fry method (Minnesota Educational Computing Consortium, 1982; Klare, 1974-1975). The instruments were altered and simplified until they were rated at the Fry grade level of 4 to 6. (For greater detail on the development of the instruments, see Ray, in press.)

Pilot Study

Stage II was a pilot study during which procedures for administration of the instrument were developed (Ray, in press). The researcher decided to use the instruments as first constructed and to read them aloud to all students.

Data Collection

Students were randomly assigned to the laboratory and non-laboratory groups and the researcher and assistant were randomly assigned to different groups for instrument administration. Those students who participated in the elicitation sessions also participated in the final administration of the instruments. The classroom teacher was asked to go somewhere away from all of the students; all teachers readily cooperated. The instruments were administered to 457 students.

Data Analysis

Statgraphics (version 2.1) (Statistical Graphics Corporation, 1986) was used for statistical analysis. The analysis followed the pattern suggested by the authors of the theory of reasoned action (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980). Multiple regression was used with behavioral intention as the dependent variable and attitude toward behavior and subjective norm as the independent variables. Pearson product-moment correlation coefficients were used to develop a correlation matrix including the variables of behavioral intention, attitude toward behavior, subjective norm, sum of salient attitudinal beliefs, and sum of salient normative beliefs. An alpha level of .10 was used for the statistical tests. This level of significance was used since the nature of this study was exploratory, and use of such an alpha level made it more likely that a potentially important difference or relationship was not overlooked (Borg & Gall, 1989). Accumulated error rate comes to bear (Good, 1984) since several significance test were conducted. However, the reader is reminded that this research was exploratory and not involved in evaluating treatments. Therefore, the accumulated error rate associated with multiple hypothesis testing was not of major concern in this study.

Findings

Concerning laboratory science, eleven behavioral beliefs accounted for 79.7% of the subjects' responses (Table 1) and six normative beliefs accounted for 79.1% of the public school subjects' responses (Table 2). Concerning non-laboratory science, eight behavioral beliefs accounted for 80.5% of the subjects' responses (Table 3) and seven normative beliefs accounted for 89.7% of the subjects' responses (Table 4). (The only apparent difference in elicited beliefs between types of schooling was that the private and home school students mentioned God two to three times more frequently, with respect

to normative beliefs, than did the public school students.) With laboratory behavioral intention as the dependent variable and attitude toward behavior and subjective norm as independent variables, the adjusted coefficient of multiple determination ($\underline{R}^2$ = .14) was significant, $\underline{F}(2, 219) = 18.56$, $\underline{n}$ = 222, $\underline{p}$ = .00 (Figure 2). With non-laboratory behavioral intention as the dependent variable and attitude toward behavior and subjective norm as independent variables, the adjusted coefficient of multiple determination ($\underline{R}^2$ = .27) was significant, $\underline{F}$ (2, 226) = 42.89, $\underline{n}$ = 229, $\underline{p}$ = .00 (Figure 3). The relative weight of the attitude toward behavior was greater than the relative weight of the subjective norm for both laboratory and non-laboratory intentions. All of the correlations between the various other adjacent constructs in the theory were significant for both of the studied behaviors.

Figures 2 and 3 and tables 5 to 10 provide quantitative information about significant relationships. In terms of laboratory science, type of school had a significant effect, $\underline{F}$ (2, 191) = 3.38, $\underline{p}$ = .04, on behavioral beliefs. Home school students were significantly higher than public and private school students. Grade level also had a significant effect, $\underline{F}$ (5, 191) = 6.36, $\underline{p}$ = .00, on behavioral beliefs. Eighth and seventh grade scores were the lowest. Gender had a significant effect, $\underline{F}$ (1, 166) = 5.95, $\underline{p}$ = .02, on normative beliefs with girls having higher scores.

In terms of non-laboratory science, grade level had a significant effect, $\underline{F}$ (5, 196) = 3.30, $\underline{p}$ = .01, on behavioral beliefs. Eighth and seventh grade scores were the lowest. Grade level also had a significant effect, $\underline{F}$ (5, 179) = 1.86, $\underline{p}$ = .10, on normative beliefs. Eighth and seventh grade scores were lowest.

Discussion

The theory of reasoned action was useful in identifying these grades 3 to 8 students' beliefs which are theoretically the determinants of their "attitude toward" and their "subjective norm" with respect to science learning behaviors. The identified beliefs in this study for students in public, private, and home schools were essentially the same as for those of public-school students only (Ray, in press). Eleven beliefs about the outcomes of doing laboratory science behavior were frequently elicited; seven beliefs for non-laboratory science were frequently elicited. Six of the beliefs about outcomes of doing

laboratory science were identical or very similar to beliefs about outcomes of doing non-laboratory science. Six normative beliefs (referents) related to doing laboratory science behavior were frequently elicited; seven beliefs for non-laboratory were elicited. The six normative beliefs for laboratory were included in the seven for non-laboratory.

As predicted by the theory of reasoned action, all of the correlations between adjacent constructs were significant. A noteworthy finding was that attitude toward behavior and subjective norm predicted a significant amount of variance in intention for both laboratory and non-laboratory behaviors. However, the amounts of variance explained in this study were not as high as in several other investigations which utilized the theory of reasoned action (e.g., Bowman & Fishbein, 1978; Hom & Hulin, 1981; Koballa, 1986, 1988; Lin, 1987; Riddle, 1980; Stead, 1985). Possible reasons (e.g., young age of subjects and homogeneity of intention) for these relatively low multiple Rs are discussed by Ray (in press). Consistent with other research using the theory of reasoned action, attitude toward behavior had a greater relative weight than subjective norm in terms of predicting behavioral intention for both laboratory and non-laboratory behaviors. Thus, it appears that attitude toward behavior lends more to the understanding of the determinants of science learning behavioral intention than does subjective norm for these grades 3 to 8 students. This suggests that (for the types of subjects and behaviors herein described) future experimental research should focus on attitude toward behavior, rather than on subjective norm, in attempts to change beliefs, attitudes, intentions, and behaviors.

A limited amount of information existed before this study with which to hypothesize the effects of the external variables. Gender only had a significant effect on normative beliefs for laboratory science in this study. This gender effect appears to be of little practical significance in this study since it is a statistical significance in only one of four possible situation and the subjective norm determinant (which is determined by normative beliefs) plays a relatively minor role in determining intention which eventually determines actual behavior.

Grade level, on the other hand, shows a decided effect on the determinants of intention and behavior in this study. Grade level has a significant impact in every case where it could with respect to

both laboratory and non-laboratory science. Previous research, showing grade level effects with respect to attitude and achievement, is confirmed in this study. The data from this study shows that intention to do science drops at around grades 6 to 8. If it is desirable and possible to alter this trend, perhaps two solutions could be considered. First, more could be done with students before grades 6 to 8 to ensure high levels of the constructs of attitude toward behavior and subjective norm. Second, perhaps the treatment should just be applied during grades 6 to 8. That is, educators could design ways (based on the beliefs herein described) to enhance the attitude toward behavior and subjective norm of these older children.

Students who are home educated have a more positive attitude toward doing laboratory science than those in public and private schools. This evidence is contrary to negative statements about the quality of home education, and corroborative of research showing high achievement and other positive learner outcomes among the home schooled. It could be argued that it is the type of student who is home schooled that makes the difference rather than the form of education. Several variables (e.g., demographic) would have to be controlled in order to test this alternative hypothesis. On the other hand, it may be that the educational environment of home schooling enhances students' intentions to "do science." Holt (1983, p. 393) suggested that the home schooling movement is "... a laboratory for the intensive and long-range study of children's learning and of the ways in which friendly and concerned adults can help them learn. It is a research project, done at no cost, of a kind for which neither the public schools nor the government could afford to pay." A careful study of what is occurring in terms of science education in the home school may reveal some enlightening findings to science educators. For example, with only 3 to 4 hours of formal "schooling" per day (Ray, 1988), perhaps the home educated have more time to explore and gain interest in their natural environment than do those in conventional schools. Maybe children in home schools engage in more extensive projects/experiments than do those in conventional schools. Or, perhaps there is something specific about what the "average" home educators do with their children that increases their intentions to do and learn science. Some qualitative research might be appropriate in answering the questions that arise in this area.

Further Research Implication

Ajzen and Fishbein (1980, p. 65) have argued that "... that a person's attitude toward a behavior is determined by the set of salient beliefs he holds about performing the behavior." Further, attitude toward behavior is a major immediate determinant of intention, which is in turn the most immediate determinant of behavior (Fishbein & Ajzen, 1975). Based upon these theoretical underpinnings and the findings of this study, salient behavioral beliefs should be focused upon by future researchers who are ultimately interested in affecting grades 3 to 8 science learners' intentions to engage in laboratory and non-laboratory behaviors.

Pedagogical Implications

The theory-generated baseline information from this study might be used in the classroom. Elementary teachers who include science in their classrooms and science content area teachers could be informed of the cores of salient attitudinal beliefs and normative beliefs of these grades 3 to 8 science learners. It is possible that emphasis on salient beliefs by teachers would enhance students' intentions to do science. That is, teachers could include the salient beliefs (discovered in this study) in discussions with students. Teachers could emphasize information related to these beliefs in order to help students have accurate information relevant to these important beliefs. Accurate beliefs about doing science might then lead to higher engagement levels in science learning activities. Eventually, researchers might use these findings to design experimental studies to test the effects of influencing salient beliefs and, ultimately, actual science learning behavior in public, private, and home schools.

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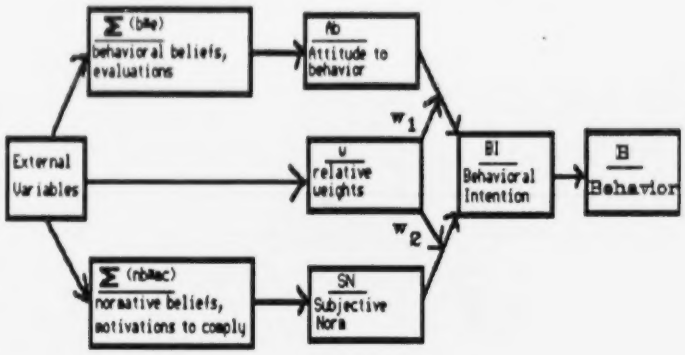

Figure 1. Fishbein and Ajzen's Theory of Reasoned Action.

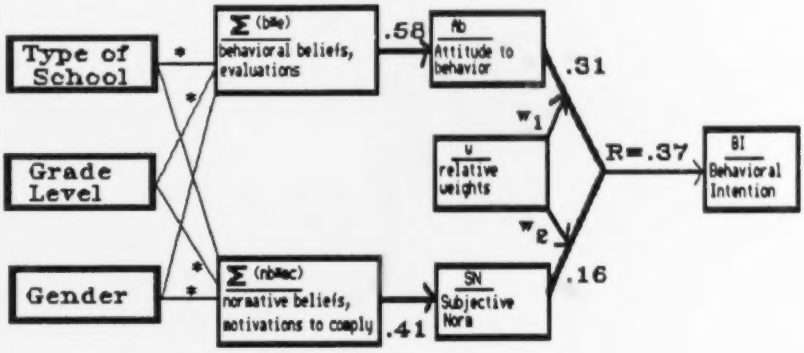

Figure 2. Results for laboratory. Correlation coefficients are shown. Asterisks represent significant effects.

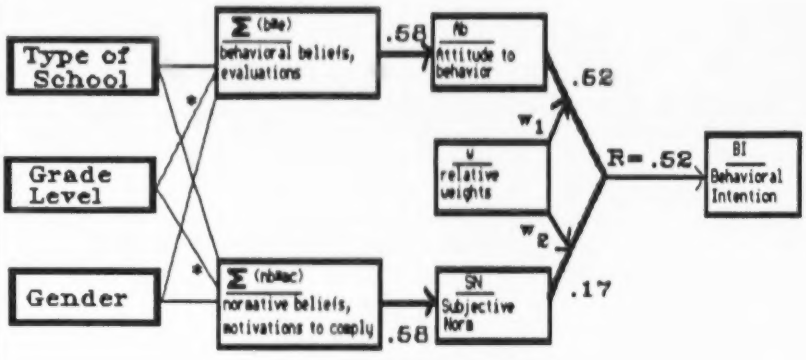

Figure 3. Results for non-laboratory. Correlation coefficients are shown. Asterisks represent significant effects.

Number	BELIEF that Doing Science Projects and Science Experiments:	Freq.	%	Cum. %
1	causes me to learn	31	19.6	19.6
2	causes me to have fun with science and enjoy science	21	13.3	32.9
3	allows me to do science activities and experiments	12	7.6	40.5
4	causes me to get good or better grades	11	7.0	47.5
5	causes me to have to do work on science assignments	11	7.0	54.4
6	causes me to be confused and not understand science	8	5.1	59.5
7	causes me to think of how a science experiment will turn out	7	4.4	63.9
8	causes me to be interested and not bored	7	4.4	68.4
9	causes me to have an experiment work well	6	3.8	72.2
10	causes me to dissect animals and touch their parts	6	3.8	75.9
11	causes dangerous things to happen	6	3.8	79.7
	various idiosyncratic beliefs	32	20.2	100.0
	Total	158		

Table 1. Modal Salient Behavioral Beliefs for Laboratory

Number	Normative BELIEF (or Referent)	Freq.	%	Cum. %
1	parents	41	37.3	37.3
2	teacher	18	16.4	53.6
3	brothers or sisters	8	7.3	60.9
4	grandparents	7	6.4	67.3
5	friends	7	6.4	73.6
6	God	6	5.4	79.1
	various idiosyncratic beliefs	23	20.9	100.0
	Total	110		

Table 2. Modal Salient Normative Beliefs for Laboratory

Number	BELIEF that Doing Science Reading and Science Writing:	Freq.	%	Cum. %
1	causes me to learn	22	19.5	19.5
2	causes me to have fun with science and enjoy science	17	15.0	34.5
3	allows me to become someone who uses science in their job	14	12.4	46.9
4	causes me to get good or better grades	10	8.8	55.8
5	causes me to think about science activities and experiments	9	8.0	63.7
6	causes me to do questions that are difficult and hard to understand	7	6.2	69.9
7	causes me to do more writing	6	5.3	75.2
8	causes me to have to do work on science assignments	6	5.3	80.5
	various idiosyncratic beliefs	22	19.5	100.0
	Total	113		

Table 3. Modal Salient Behavioral Beliefs for Non-Laboratory

Number	Normative BELIEF (or Referent)	Freq.	%	Cum. %
1	parents	36	37.1	37.1
2	teacher	12	12.4	49.5
3	grandparents	11	11.3	60.8
4	relatives	11	11.3	72.2
5	brothers or sisters	7	7.2	79.4
6	friends	5	5.2	84.5
7	God	5	5.2	89.7
	various idiosyncratic beliefs	10	10.3	100.0
	Total	97		

Table 4. Modal Salient Normative Beliefs for Non-Laboratory

Grade	Mean	Homogeneous Groups
8	11.84	*
7	17.33	* *
4	18.88	*
6	19.31	*
3	21.46	* *
5	26.38	*

Table 5. Laboratory - post hoc multiple range analysis for grade level and behavioral beliefs.

Type	Mean	Homogeneous Groups
Private	14.35	*
Public	19.06	*
Home	26.31	*

Table 6. Laboratory - post hoc multiple range analysis for type of school and behavioral beliefs

Gender	Mean	Homogeneous Groups
Male	24.74	*
Female	30.88	*

Table 7. Laboratory - post hoc multiple range analysis for gender and normative beliefs

Grade	Mean	Homogeneous Groups
8	18.59	*
3	27.00	* *
6	27.87	* *
4	29.13	*
7	31.11	*
5	35.61	*

Table 8. Laboratory - post hoc multiple range analysis for grade level and normative beliefs

Grade	Mean	Homogeneous Groups
8	10.83	*
7	11.90	*
4	12.31	*
5	12.58	*
6	14.71	* *
3	18.00	*

Table 9. Non-Laboratory - post hoc multiple range analysis for grade level and behavioral beliefs

Grade	Mean	Homogeneous Groups
8	28.76	*
7	32.19	* *
4	34.11	* *
5	34.19	* *
3	40.73	*
6	41.18	*

Table 10. Non-Laboratory - post hoc multiple range analysis for grade level and normative beliefs

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